

STATISTICS OF SECONDARY HÆMORRHAGE AFTER AMPUTATION

WITH STATISTICS OF AMPUTATIONS AT GUY'S HOSPITAL
FOR FORTY-TWO YEARS.

BY JOHN POLAND.

SEEING that no detailed or complete statistical report of secondary hæmorrhage after amputations has recently been published, it appeared that a record of the cases which have occurred at Guy's Hospital during the years 1877—1886 might be worth publication in the 'Reports,' in addition to those already reported for 1867—1876 inclusive. Both these series of figures differ very considerably from those given heretofore by different observers. Thus Mr. Callender, in vol. xlvii of the 'Med.-Chir. Trans.,' "On Amputations performed at St. Bartholomew's Hospital during the years 1853—1863," gives the following among the chief causes of 74 deaths after 358 amputations ; 6 cases of death from secondary hæmorrhage. Of the primary amputations, 1 death from secondary hæmorrhage in a thigh amputation ; of the secondary, 1 death from this cause in an arm, 1 in a thigh, and 1 in a leg amputation. Of all other amputations, 1 death in a thigh and 1 in a leg amputation. The rate of mortality from secondary hæmorrhage in the total of fatal cases he found to be : For primary amputations, 1 case in a total of 15 deaths ; for secondary amputations, 3 cases in 13 deaths (or 1 in 4·3), 23 per cent. ; for all other amputations, 2 cases in 46 deaths (or 1 in 23). Of the total 74 fatal cases 8·1

per cent. died from secondary hæmorrhage. In his total figures of deaths from hæmorrhage Mr. Callender included 3 cases of death from recurrent hæmorrhage, which brought up the percentage to 12·1 deaths from hæmorrhage.

Also Mr. Bryant, in vol. xlii of the 'Transactions' of the same society, published a paper on the causes of death after amputation, with a statistical account of 300 amputation cases from 1845—1859. Of a total of 76 fatal cases there were: Among—

Primary amputations, 1 case of secondary hæmorrhage from the thigh (9 per cent.), and 1 case of secondary hæmorrhage from the arm (50 per cent.).

Secondary amputations, 1 case of secondary hæmorrhage from the leg (12·5 per cent.)

Pathological amputations, 1 case of secondary hæmorrhage from the thigh (5·5 per cent.) ; 1 case of secondary hæmorrhage from the leg (33·3 per cent.)

Of the total amputations of the thigh (2 cases), 5 per cent. ; leg (2 cases), 7 per cent. ; arm (1 case), 33·3 per cent.

Of primary amputations (2 cases), 7 per cent. of fatal cases.

Of secondary „ (1 case), 8·3 „ „ „

Of pathological „ (2 cases), 9·5 „ „ „

Making a total of 7 per cent. of fatal cases, or 1·66 per cent. for the whole number of amputations. Five deaths from traumatic complications were excluded in the calculation of these percentages.

Percentage of deaths from secondary hæmorrhage in the total for the different amputations :

Thigh.			Leg.			Arm.	Total.			
Patho-logical.	Primary.	Total.	Patho-logical.	Sec-on-dary.	Total.	Total.	Patho-logical.	Primary.	Sec-on-dary.	Total.
1	5	1·4	2·5	8	2·4	3	1·4	2·6	4	1·66

Again, in vol. iii (1870) of the Clinical Society's 'Transactions,' Mr. Callender, in a "Note on Cases of Amputation in which Ligatures have been used," remarks, in the first place with reference to secondary hæmorrhage, that he had elsewhere published the results of 358 amputations performed at St. Bartholomew's Hospital.¹ Of this number 74 died, and of these 5 died from secondary bleeding; a sixth case

¹ 'Med.-Chir. Trans.,' vol. xlvii.

was reported as dying from purpura and blood-oozing. These cases extended over a period of eleven years, from January, 1853, to October, 1863. The following figures showed the results of amputations at St. Bartholomew's Hospital from January 1st, 1869, to January 1st, 1870. Total number of cases 46. Total number of deaths 7, or 1 in every 6·5 died, or 15·2 in every 100. No cases of secondary hæmorrhage. Adding to the first-named 358 cases the amputations referred to below, and which had been treated since October, 1863, he had 480 operations with 6 deaths from secondary hæmorrhage, or 1 in 80, or 1·2 in 100. In the personal experience of Mr. Paget and Mr. Callender, only twice had secondary bleeding occurred out of 108 cases. Of the 2 cases, in 1 it was predicted on account of the excessively tight application of the ligature. The ligature cut through the femoral artery and there was severe bleeding on the fifth day. In the second case the patient recovered after ligature of the common femoral. He therefore considered himself justified in stating that secondary bleeding was a comparatively rare occurrence after tying main arteries.

Such figures as these, taken from one surgeon's practice, and ranging over so short a period, cannot but be misleading. In the practice of the whole surgical staff of Guy's Hospital during the two years 1878, 1879 there were no cases of secondary hæmorrhage, either fatal, severe, or slight.

Now, in all the figures just quoted, and in those of which the writer has been able to avail himself, no calculation, and but a passing mention, is made of cases of secondary hæmorrhage from amputation wounds, which are treated and ultimately recover. Yet it cannot be doubted that these too in their clinical aspect should be taken into consideration if we wish to trace its causation. It is true, as will be seen by the Tables accompanying this paper, that death from secondary hæmorrhage is of the greatest rarity at the present time, and unquestionably this diminution in frequency is largely due to the advances gained in the antiseptic treatment of wounds. Thus, out of the 641 amputations during the ten years 1877—1886, there were 6 in which death resulted from this cause, but absolutely 5, for in one, although this took place from exhaustion and suppuration four months after

the date of the operation, yet repeated bleeding contributed in great measure to the fatal result. Taking the 6 we get a percentage of $\cdot 93$, or 1 in 106·7, for all amputations; if the 5, $\cdot 78$ per cent., or 1 in 128·2. In the same way Mr. Bryant's figures yield 1·66 per cent. Comparing the rate of mortality from secondary hæmorrhage in the total of 143 fatal cases we find a percentage of 4·1 instead of 7·04 given by Mr. Bryant, and almost exactly one half of that by Mr. Callender.

Turning to the cases of secondary hæmorrhage, many of which were slight, and all ending in recovery, we find there were 10 in 498 cases of recovery, a percentage of 2·008, or 1 in 49·8.

By adding these two series together there is a total of 16 in 641 amputations, or a percentage of 2·6.

An examination of these Tables shows that out of 168 *primary* amputations there were 3 cases of slight bleeding, 1·7 per cent. for the whole number, but no deaths from this cause. Out of 77 *secondary* amputations there were 2 cases, one of which was fatal, making a percentage of 2·4 for the whole, and 1·2 of fatal cases for the whole number, and a percentage of 3·5 in the total fatal cases in this division. Out of 334 *pathological* amputations there were 10 cases, 4 of which were the cause of death, making a percentage of 2·9 for the whole, and a percentage of 1·1 of fatal cases for the whole number, and a percentage of 6·06 for total fatal cases in this division. Out of 62 cases of *expediency* there was one fatal case, making a percentage of 1·6 for the whole, and a percentage of 14·2 fatal cases out of the total fatal cases.

This second decade of cases might be compared with the first (1867—1876) previously published in the 'Lancet,' 1878, and quoted by Mr. Clement Lucas in vol. xxiv (1879) of the 'Guy's Hospital Reports.' Out of 543 amputations there was a total of 27 cases of secondary hæmorrhage recoverable and fatal, or a percentage of 4·9 for total number of cases. Although this appears so high, it may be accounted for partly by the local treatment of the vessels, *e. g.* acupressure, partly by that of the wounds themselves. These figures will be alluded to presently.

The *etiology* of secondary hæmorrhage is a point of considerable interest. Like many other diseases, whose cause is a matter of speculation, the condition which gives rise to its production is apparently due to many factors, and it should be determined as far as possible what each of these may be, and their exact comparative value. A critical examination of every case, whether slight, severe, or fatal, must therefore be of the greatest importance, and consequently we should not be content in recording, as others have done, only those in which death has been a direct result. It is evident that the latter furnish us pathologically with the most trustworthy data, yet final conclusions cannot be drawn from them.

Among *local* causes, it will be found that some arteries are more frequently affected than others; of these the femoral artery must be placed first. In the subjoined Tables, out of a total of 16 cases of secondary hæmorrhage there are 11 from the femoral artery (thigh 9, hip 2), a percentage of 68·7; 3 of the popliteal, a percentage of 18·7; 1 of the forearm and 1 of the foot. And in the Tables for 1867—76, out of 27 cases 13 were from the femoral, a percentage of 48·1. Adding the two periods together (twenty years), out of a total of 43 cases 55·8 per cent. were of the femoral artery, and out of the total 239 amputations of the thigh and hip (1877—1886) secondary hæmorrhage ensued in 4·6 per cent. Out of the total 6 deaths from secondary hæmorrhage in the same period, 5 were from the femoral, making a percentage of 2·09 deaths from secondary hæmorrhage in the total of these amputations. The sixth case of death was from the popliteal artery.

Secondary bleeding does not appear to be dependent to any great extent upon the present modes of occlusion of the vessels. In the Tables for 1867—76,¹ out of 543 amputations, 73 dying within the first few days were excluded; in 64 cases the silk ligature was employed and followed by secondary hæmorrhage in 5 cases, 1 in every 12·8, or 7·812 per cent.; in 19 cases of acupressure secondary hæmorrhage followed in 6 cases, 1 in 3·1 cases, or 32·6 per cent.; in 355 of torsion secondary hæmorrhage occurred in 14 cases, 1 in

¹ 'Guy's Hospital Reports,' series 3, vol. xxiv.

25·3, or 3·66 per cent.; in 31 cases of carbolized catgut ligature, 2 cases occurred, 1 in 15·5 or 6·45 per cent. However, in analysing the cases for 1877—1886, secondary bleeding was found to occur as much after one form of occlusion as the other, provided a septic ligature was not employed.

Undoubtedly, an extensive sloughy condition of the wound was formerly a fertile source of hæmorrhage—and even now an unhealthy process going on in it is to be regarded as the most important factor of all, notwithstanding that every effort may have been made to obtain asepsis in the wound. This was the case in two of those given in the accompanying Tables.

Arteries appear to be unable to resist, as they do some other forms of infection, the influence of this unhealthy process, which sets up in their coats a form of suppurative arteritis. In the Pathological Society's 'Transactions,'¹ Mr. Symonds gives a good description of this condition and drawings of the microscopical appearance of the changes in the vessel, from "a case of aneurysmal dilatation of the radial artery with suppurative arteritis."

This cannot always be a purely local condition, but is frequently associated with, or secondary to, a general state of the system, probably septicæmic in many cases. Indeed, Dr. B. A. Watson, of Philadelphia, is of opinion that all cases of secondary hæmorrhage are due to septic infection, and writes:² "I employ the term secondary hæmorrhage with especial reference to the fact that it is not always to be regarded as a secondary wound complication, while septic infection is the primary."

The view that the closure of blood-vessels depends more on healthy plastic inflammation than on the formation of the clot, is borne out by the experiments of Messrs. Ballance and Edmunds,³ "on the ligation of the larger arteries in their continuity." As Ziegler states, the lining of the blood-vessels is analogous to that of serous cavities, and a general

¹ 'Path. Soc. Trans.,' vol. xxxv, 1884, p. 146.

² 'On Amputations of the Extremities and their Complications,' Edinburgh edition, 1885, p. 533.

³ 'Med.-Chir. Trans.,' vol. lxi, p. 443.

condition (of cachexia) must, therefore, considerably alter what should be healthy plastic inflammation. This explains the frequency with which we find, in patients who have died from other causes, the ends of the vessels in their stumps firmly healed, and the reparative process complete, yet but little clot present, and often at the same time a collateral branch immediately above the occluded end. This anatomical state of the vessels can therefore have but little influence in causing secondary hæmorrhage, provided that other conditions are equal and plastic inflammation present.

It is interesting to note the large proportion of cases following amputation for disease, 11 out of 16 cases; and of the 6 deaths from this, all except 1 were in this division. Only 3 after primary and 2 after secondary amputations; death in 1 of the latter.

As to *age*, this ranged from 15 to 61 years; a large majority, 10 out of the 16, occurred between 20 and 36 years.

From the post-mortem records calcareous arteries do not appear to predispose to secondary hæmorrhage, neither does visceral disease to the extent that is generally supposed. Of the 5 fatal cases in which the post-mortem condition is given, it is carefully noted in 4 that all the viscera were healthy. In the fifth, Case 12, in which the patient succumbed four months after the amputation from repeated hæmorrhage and exhaustion, there were lardaceous viscera and some evidence of syphilis. Syphilitic arteritis is responsible for a certain number of cases. In Case 2, in which the patient recovered, an aneurysm had developed after amputation at the knee-joint for compound fracture of the leg, taking place at the site of long-standing syphilitic necrosis of the tibia.

The following are the post-mortem notes of 5 of the fatal cases, of the sixth (Case 8), unfortunately no post-mortem examination was made.

CASE 4. *Secondary hæmorrhage from popliteal artery on thirty-third day after secondary amputation at the knee-joint (on nineteenth day) for compound fracture of tibia and fibula.*

—Tetanus. Suppuration and ulceration of popliteal artery. Death on thirty-third day. Patient æt. 30.

The stump at the right knee-joint presented on either side an almost level granulating surface, from one of which there ran an abscess up the anterior aspect of the femur, containing about 8 oz. of bad-smelling pus, and on the posterior aspect another granulating surface, running vertically up the posterior flap and ending in a sinus at its upper limit, connected with a small abscess cavity in the position of the end of the popliteal artery. From this sinus a good-sized stream flowed when water was injected by means of a syringe into the common iliac artery. The walls of the abscess cavity were composed of soft, flocculent, shreddy slough, and there was an entire absence of granulation-tissue. About the centre of this abscess the twisted end of the popliteal artery lay, and presented a most interesting condition. Suppuration had taken place between its middle and inner coats (see Plate), and passed upwards in such a manner as to completely separate the two for a distance of two inches. The internal coat thus lay like a cast in the lumen of the vessel, and looked at first sight not unlike a coagulum. The upper part of this inner coat was thin and papery, and at its extreme upper limit of separation from the outer coats fairly abrupt and well defined. The lower three quarters of an inch shaggy, thickened, soft, and sloughy, lay loose in the abscess cavity. This tube-like inner coat presented an opening into the lumen of the vessel above, and for a distance of one eighth of an inch contained the remains of some broken-up adherent coagulum. It was from the lower orifice of this that the fatal hæmorrhage had taken place. Corresponding to the whole length of this suppuration in the tunics the external coats were found to be thickened by inflammatory material to double their normal size, and this condition extended upwards for a quarter of an inch above the upper limit of separation of the coats. Above this, all the arterial coats appeared to be healthy. Below, the thickened coats became continuous with the lining of the abscess cavity and blended imperceptibly with it. The femoral vein was plugged for a distance of five inches with adherent clot. The suppuration

around the popliteal artery had no ascertainable connection with the suppuration extending up the front of the thigh. All the organs were healthy.

CASE 7. *Secondary hæmorrhage on fifteenth and twenty-first days after amputation of the thigh for osteo-myelitis of femur with abscess of thigh and sinuses.*—Ligature of femoral artery on fifteenth day. Death on twenty-first day from secondary hæmorrhage from the profunda vein. Patient æt. 16. The following are Dr. Goodhart's notes :

"The stump of the thigh was gaping widely, and looked dry and actionless. The wound in the thigh for ligature of the femoral artery in the same way, though between four and five days old, looked so like a post-mortem wound that I asked if anyone had been tying the artery post mortem, not knowing at that time the nature of the case. The gut ligatures on the vessels, of which I counted three sets, one on the femoral, another bunch on the inner side of the stump in the neighbourhood of large branches of the internal circumflex, and some near the bone; they were all tough still and rather rigid, showing, that is to say, very little tendency to absorption, and ? indicating an absence of reparative action in the wound. The bleeding seemed to have come from the internal circumflex branches, but the settlement of the point was reserved for further examination. All the parts were removed, with the adjacent parts of the pelvis and hip-joint. There was no disease of the other joints or bones. Lungs quite bloodless, healthy; no ecchymosis or evidence of any septic state. Heart-muscle pale but not distinctly fatty. Liver rather fatty. Rest of viscera healthy but bloodless."

"I made a careful examination of the stump subsequently, and found a good deal of suppuration running up the inner side of the stump. The arteries were quite closed, but a large branch of the profunda vein had been ulcerated into and was lying open at the bottom of the flaps in the adductor region of the thigh."

CASE 12. *Amputation of the thigh for extensive suppuration following osteotomy for ankylosis of hip. Frequent hæmor-*

rhage. Gradual exhaustion.—Early lardaceous viscera. Thrombosis of iliacs, femorals, and inferior vena cava.—Patient æt. 20. The following are from Dr. Goodhart's notes :

"Stump close to hip, with sinuses and burrowing abscesses, one of which ran up into the pelvis along the iliacus. Flaps well united round the bone, and there was a good deal of repair. The granulation-tissue, though, did not look healthy, it was caseous-looking when the flaps were forcibly separated. Extensive old thrombosis up to the origin of the renals and a transverse section of the cava below this showed it to be contracted, its coats thickened, and its canal entirely occluded by a flaccid, greenish organised material, in the centre of which were two small sinuses with cavernous walls, as if the clot had softened here. The iliacs were also plugged, and the left, which was examined more particularly, showed its canal occupied by an organised material. The arteries were closed, aortic vessels healthy. All the viscera were lardaceous."

CASE 13. *Severe secondary hæmorrhage on seventh day after amputation of the thigh for disorganisation of the knee-joint of two years' duration.*—Ligature of femoral artery. Death. Local arteritis. Patient æt. 53. The following notes are by Dr. Carrington :

"Amputation flaps sloughy and unhealthy looking, and their surfaces not granulating. The left femoral artery was diseased for a distance of four inches above the twisted end ; it was thickened, dilated, and corrugated. It appeared as though a local arteritis had started from about the diseased joint. The artery was found to be ligatured and quite empty of clot. The other arteries in the body were in good condition. No pus in joints. Heart-muscle pale, otherwise healthy. Kidneys and other viscera healthy."

CASE 16. *Secondary hæmorrhage on sixteenth and eighteenth days after amputation at the hip-joint for sarcoma of thigh.*—Burrowing of pus upwards. Pyæmia. Death eighteenth day. Purulent phlebitis. High origin of profunda and ulceration. Patient æt. 21. The following are Dr. Goodhart's notes :

“Pus burrowed about the floor of the wound in all directions, especially round the main vessels; at the outer side of these an abscess ran up into the pelvis and under Poupart’s ligament. The cavity contained recent blood-clot, and it was evident the hæmorrhage was from here; and on examining the vessels the superficial and deep femoral were found to come off together under Poupart’s ligament, and, after coursing an inch or so downwards, the profunda opened straight into the abscess sac. The direction of the artery opened was rather that of the external circumflex, but since the profunda itself could not be traced beyond its abruptly opened end, it seems that the sloughing had led to ulceration of the vessel at its point of splitting into its branches, for it was not known to have been touched at the operation. The femoral artery contained clot for half an inch or so below Poupart’s ligament above where it had been twisted, but the clot was soft and pus-like, and by no means safe. The femoral and external iliac veins, also branches of the internal iliac, were full of thick greenish pus, and the profunda vein opened also into the abscess sac, but its contents were pus; several veins running about the groin contained pus. Pyæmic abscesses in lungs. Kidneys and all viscera healthy. All joints healthy. It was thought he had died from the hæmorrhage, but with abscesses in the lungs to the amount he had the end could only have been hastened.”

Amputations.

The subjoined statistical Tables of amputations for twelve years (1875—1886) form partly a continuation of those published in the ‘Guy’s Hospital Reports,’ series iii, vol. xxi, 1876, for fifteen years (1860—1874), 559 cases, and partly a continuation of those given by Mr. Bryant in the ‘Med. Chir. Trans.,’ vol. xlii (1845—1859) for fifteen years, 300 cases; all of which, if taken together, comprise a continuous period of forty-two years with a total of 1641 amputations. The Tables for the twelve years (1875—1886) record, like the others, all cases treated by the surgeons of Guy’s Hospital during that period, amounting to 782 cases. These have been arranged

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for comparison, like those given by Mr. Golding-Bird, in three periods of life, before 20, between 20 and 40, and over 40 years of age, and Tables combining the years 1860—1886 for these three periods have been added.

The figures throughout these Tables¹ show a marked diminution in the rate of mortality as compared with that given by Mr. Golding-Bird, certainly due to the more careful dressing of wounds. This diminished death-rate is most marked on comparing the total results of twelve years (1875—1886) with the preceding fifteen years. Here in the total 782 cases the death-rate for all ages is 23·6 per cent.; or 1 in 4·2, and that for 559 cases (1860—1874) 35·4 per cent., or 1 in 2·8

1875—1886.		1860—1874.	
Primary amputations	25·4 per cent.	Primary amputations	43·2 per cent.
Secondary „	40·4 „	Secondary „	58·5 „
Pathological „	20·6 „	Pathological „	26·7 „
Expediency „	12·8 „	Expediency „	25·3 „

Taking the three different periods of life :

Up to 20 years of age.

1875—1886.		1860—1874.	
Total death-rate	16·7 per cent. or 1 in 5·9.	Total death-rate	21·4 per cent. or 1 in 4.
Primary amputations	17·1 per cent.	Primary amputations	15·3 per cent.
Secondary „	31·2 „	Secondary „	50 „
Pathological „	16·2 „	Pathological „	16·04 „
Expediency „	7·6 „	Expediency „	35 „

21—40 years of age.

1875—1886.		1860—1874.	
Total death-rate	19·6 per cent. or 1 in 5·09.	Total death-rate	34·9 per cent. or 1 in 2·8.
Primary amputations	17·4 per cent.	Primary amputations	39·7 per cent.
Secondary „	37·03 „	Secondary „	44·4 „
Pathological „	18·3 „	Pathological „	32·6 „
Expediency „	12 „	Expediency „	22·2 „

¹ For the purpose of analysis the usual classification of amputations has been made by the terms : Primary, for those of accident before the first twenty-four hours, and Secondary, for those after that period ; Pathological, those for disease, and amputations of expediency, as given by Mr. Bryant, those for tumours, deformities, and other conditions of a similar character. Amputations at the knee are placed under those of the leg, wrist and elbow under forearm.

Over 40 years of age.

1875—1886.		1860—1874.	
Total death-rate	36·5 per cent. or 1 in 2·7.	Total death-rate	47·8 per cent. or 1 in 2·09.
Primary amputations	42·4 per cent.	Primary amputations	66· per cent.
Secondary „	45·09 „	Secondary „	75·8 „
Pathological „	31·4 „	Pathological „	30·5 „
Expediency „	21·05 „	Expediency „	20·8 „

For the twenty-seven years between 20 and 40 years of age there is a percentage of 27·2 for all amputations compared with 18·2 per cent. before 20 years, and of primary amputations between 20 and 40 years of age, a percentage of 29·007 compared with 17·2 per cent. before 20 years.

These figures illustrate well the influence of age on the death-rate, and maintain the accuracy of the observations of Sir James Paget on the periods of life favorable to surgical operations;¹ also of Holmes, Spence, Malgaigne, and other writers.

As to the different forms of amputation :

	1875—1886.	1845—1874.	1845—1886.
Amputation—Hip . .	54·5 per cent. ...	... 54·5 per cent.	...
„ Thigh . .	29·1 „ ...	35·6 per cent. ...	32·9 „
„ Leg . .	25·3 „ ...	35·7 „ ...	31·3 „
„ Foot . .	6·6 „ ...	9·3 „ ...	7·1 „
„ Shoulder	50 „ ...	36 „ ...	44·4 „
„ Arm . .	24·7 „ ...	26·3 „ ...	25·5 „
„ Forearm	1·7 „ ...	16·7 „ ...	10·5 „

Of the total traumatic cases (1875—1886), out of 214 cases 92 died, or 30·06 per cent. compared with 47·8 per cent. for 1860—1874. Taking the same cases for the forty-two years there are 640 cases and 249 deaths, giving a percentage of 38·9 or 1 in 2·5.

In the same period (1875—1886) out of 23 primary *double* amputations 11 recovered, and the ages extended between 8 and 63 years. Of the 12 deaths 4 were after amputation of both thighs between 17 and 45 years of age, 4 of amputation of both legs between 20 and 63 years of age, 1 of the leg and forearm at 16, 1 of the leg and forearm at 43, 1 of both arms at 35, 1 of thigh and leg at 42 years

¹ 'Clinical Lectures and Essays,' 1885.

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of age. Of the recoveries 4 were of both legs between 8 and 46, 1 of both thighs at 18, 1 of thigh and forearm at 19, 1 of shoulder and knee at 19, 1 of leg and foot at 28, 1 of arm and forearm at 33, 1 of foot and leg at 19, and 1 of both feet at 35 years of age.

Of 14 *re-amputations* for painful, conical, or ulcerative condition of the stump ranging between 9 and 46 years of age, 8 were of the thigh, 5 of the leg, and 1 of the arm, all terminating in recovery.

The rate of mortality for the total 1641 cases (1845—1886) for all ages is 27·9 per cent., or 1 in 3·5.

Primary amputations	.	.	34·9 per cent.
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Secondary	„	.	.	48·4	„
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Pathological	„	.	.	20·9	„
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Expediency	„	.	.	21·2	„
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Of these (1845—1886) traumatic cases there were :

Amputation—Thigh (154 cases)	.	51·9 per cent. deaths.
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„	Leg (239 cases)	.	45·6	„	„
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„	Foot (31 cases)	.	9·6	„	„
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„	Shoulder (22 cases)	.	45·4	„	„
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„	Arm (118 cases)	.	31·3	„	„
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„	Forearm (76 cases)	.	13·1	„	„
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Statistics of amputations at St. Bartholomew's Hospital in periods of ten years are given by the surgical registrars in vol. xi (1875), vol. xviii (1882), vol. xx (1884), vol. xxviii (1887), and in statistical Tables (for 1875—1884) of 'St. Bartholomew's Hospital Reports.'

TABLE I.—Amputations. For 42 years (1845—1886), all ages.

	Primary			Secondary			Pathological.			Expediency.			Total.		
	Re-covered.	Died.	Per cent.	Re-covered.	Died.	Per cent.	Re-covered.	Died.	Per cent.	Re-covered.	Died.	Per cent.	Re-covered.	Died.	Per cent.
Hip . . .	...	...	...	...	...	...	12	14	53·8 or 1 in 1·8	3	4	57·1 or 1 in 1·7	15	18	54·5 or 1 in 1·8
Thigh . . .	55	43	43·8 or 1 in 2·2	19	37	66·07 or 1 in 1·5	301	112	27·1 or 1 in 3·6	50	17	25·3 or 1 in 3·9	425	209	32·9 or 1 in 3·03
Leg . . .	91	75	45·1 or 1 in 2·2	39	34	46·5 or 1 in 2·1	154	29	15·8 or 1 in 6·3	40	10	20 or 1 in 5	324	148	31·3 or 1 in 3·1
Foot . . .	18	2	10 or 1 in 10	10	1	9·09 or 1 in 11	100	7	6·5 or 1 in 15·2	14	1	6·6 or 1 in 14	142	11	7·1 or 1 in 12·9
Shoulder . . .	12	7	36·8 or 1 in 2·7	...	3	100 or 1 in 1	1	1	50 or 1 in 2	2	1	33·3 or 1 in 3	15	12	44·4 or 1 in 1·2
Arm . . .	62	25	28·7 or 1 in 3·4	19	12	37·5 or 1 in 3·08	38	6	13·6 or 1 in 7·3	15	3	16·6 or 1 in 6	134	46	25·5 or 1 in 2·9
Forearm . . .	56	6	9·6 or 1 in 10·3	10	4	28·5 or 1 in 3·5	48	4	7·6 or 1 in 13	13	1	7·1 or 1 in 14	127	15	10·5 or 1 in 8·4
Total . . .	294	158	34·9 or 1 in 2·8	97	91	48·4 or 1 in 2·06	654	173	20·9 or 1 in 4·7	137	37	21·2 or 1 in 4·7	1182	459	27·9 or 1 in 3·5

TABLE II.—*Amputations. For 27 years (1860—1886), all ages.*

	Primary.			Secondary.			Pathological.			Expediency.			Total.		
	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.
Hip . . .	...	...	...	...	...	...	12	14	53·8 or 1 in 1·8	3	4	57·1 or 1 in 1·7	15	18	54·5 or 1 in 1·8
Thigh . . .	47	31	39·7 or 1 in 2·5	18	34	65·3 or 1 in 1·5	219	94	30·03 or 1 in 3·3	37	11	22·9 or 1 in 4·3	321	170	34·6 or 1 in 2·8
Leg . . .	82	60	42·2 or 1 in 2·3	35	26	42·6 or 1 in 2·3	118	26	18·05 or 1 in 5·5	38	6	13·6 or 1 in 7·3	273	118	30·1 or 1 in 3·3
Foot . . .	17	2	10·5 or 1 in 9·5	10	1	9·09 or 1 in 11	95	7	6·8 or 1 in 14·5	14	1	6·6 or 1 in 15	136	11	7·4 or 1 in 13·3
Shoulder . . .	10	7	41·1 or 1 in 2·4	...	3	100 or 1 in 1	1	1	50 or 1 in 2	1	1	50 or 1 in 2	12	12	50 or 1 in 2
Arm . . .	52	22	29·7 or 1 in 3·3	15	11	42·3 or 1 in 2·3	28	6	17·6 or 1 in 5·6	12	3	20 or 1 in 5	107	42	28·1 or 1 in 3·3
Forearm . . .	43	3	6·5 or 1 in 15·3	7	4	36·3 or 1 in 2·7	35	4	10·2 or 1 in 9·7	9	1	10 or 1 in 10	94	12	11·3 or 1 in 8·8
Total . . .	251	125	33·2 or 1 in 3·008	85	79	48·1 or 1 in 2·1	508	152	23·03 or 1 in 4·3	114	27	19·1 or 1 in 5·2	958	383	28·5 or 1 in 3·5

TABLE III.—Amputations. For 27 years (1860—1886), over 40 years of age.

	Primary.			Secondary.			Pathological.			Expediency.			Total.		
	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Total.
Hip . . .	...	...	...	...	...	...	1	...	...	...	1	100 or 1 in 1	1	1	2 50 or 1 in 2
Thigh . . .	14	13	48·1 or 1 in 2·07	5	16	76·1 or 1 in 1·3	38	25	39·6 or 1 in 2·5	9	2	18·1 or 1 in 5·5	66	56	122 45·9 or 1 in 2·1
Leg . . .	23	37	61·6 or 1 in 1·6	15	19	55·8 or 1 in 1·7	31	18	36·7 or 1 in 2·7	15	3	16·6 or 1 in 6	84	77	161 47·8 or 1 in 2·09
Foot . . .	4	...	...	8	1	11·1 or 1 in 9	22	6	21·4 or 1 in 4·6	1	1	50 or 1 in 2	35	8	43 18·6 or 1 in 5·3
Shoulder . . .	4	3	42·5 or 1 in 2·3	...	2	100 or 1 in 1	1	...	...	...	...	...	5	5	10 50 or 1 in 2
Arm . . .	9	13	59·09 or 1 in 1·6	6	6	50 or 1 in 2	8	4	33·3 or 1 in 3	5	2	28·5 or 1 in 2·5	28	25	53 47·1 or 1 in 2·1
Forearm . . .	3	...	...	1	1	50 or 1 in 2	21	2	8·6 or 1 in 11·5	4	...	...	29	3	32 9·3 or 1 in 10·6
Total . . .	57	66	53·6 or 1 in 1·8	35	45	56·2 or 1 in 1·7	122	55	31·07 or 1 in 3·2	34	9	20·9 or 1 in 4·9	248	175	423 41·3 or 1 in 2·4

TABLE IV.—*Amputations. For 27 years (1860—1886), 21—40 years of age inclusive.*

	Primary.			Secondary.			Pathological.			Expediency.			Total.		
	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.
Hip . . .	...	...	...	...	...	...	2	4	66·6 or 1 in 1·5	1	3	75 or 1 in 1·3	3	7	70 or 1 in 4
Thigh . . .	16	9	36 or 1 in 2·7	10.	13	56·5 or 1 in 1·7	65	41	38·6 or 1 in 2·5	14	4	22·2 or 1 in 4·5	105	67	38·9 or 1 in 2·5
Leg . . .	32	17	34·6 or 1 in 2·8	13	6	31·5 or 1 in 3·1	37	4	9·7 or 1 in 10·2	12	1	7·6 or 1 in 13	94	28	22·9 or 1 in 4·3
Foot . . .	6	2	25 or 1 in 4	2	...	...	34	...	...	8	...	...	50	2	3·8 or 1 in 26
Shoulder . . .	...	2	100 or 1 in 1	...	...	...	...	...	...	1	...	...	1	2	66·6 or 1 in 1·5
Arm . . .	18	5	21·7 or 1 in 4·6	5	2	28·5 or 1 in 3·5	13	2	13·3 or 1 in 7·5	3	1	25 or 1 in 4	39	10	20·4 or 1 in 4·9
Forearm . . .	21	3	12·5 or 1 in 8	2	1	33·3 or 1 in 3	6	2	25 or 1 in 4	4	...	...	33	6	15·3 or 1 in 6·5
Total . . .	93	38	29·007 or 1 in 3·4	32	22	40·7 or 1 in 2·4	157	53	25·2 or 1 in 3·9	43	9	17·3 or 1 in 5·7	325	122	27·2 or 1 in 3·6

TABLE V.—Amputations. For 27 years (1860—1886), to 20 years of age inclusive.

	Primary.			Secondary.			Pathological.			Expediency.			Total.		
	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.
Hip . . .	...	...	...	...	...	...	9	10	52·6 or 1 in 1·9	2	...	...	11	10	47·6 or 1 in 2·1
Thigh . . .	17	9	34·6 or 1 in 2·8	3	5	62·5 or 1 in 1·6	116	28	19·4 or 1 in 5·8	14	5	26·3 or 1 in 3·9	150	47	23·8 or 1 in 4·1
Leg . . .	27	6	18·1 or 1 in 5·5	7	1	12·5 or 1 in 8	50	4	7·4 or 1 in 13·5	11	2	15·3 or 1 in 6·5	95	13	12·03 or 1 in 8·3
Foot . . .	7	...	...	...	...	...	39	1	2·5 or 1 in 40	5	...	...	51	1	1·9 or 1 in 52
Shoulder . . .	6	2	25 or 1 in 4	...	1	100 or 1 in 1	...	1	100 or 1 in 1	...	1	100 or 1 in 1	6	5	45·4 or 1 in 2·2
Arm . . .	25	4	13·7 or 1 in 7·3	4	3	42·8 or 1 in 2·3	7	...	...	4	...	...	40	7	14·8 or 1 in 6·7
Forearm . . .	19	...	...	4	2	33·3 or 1 in 3	8	...	...	1	1	50 or 1 in 2	32	3	8·5 or 1 in 11·6
Total . . .	101	21	17·2 or 1 in 5·8	18	12	40 or 1 in 2·5	229	44	16·1 or 1 in 6·2	37	9	19·5 or 1 in 5·1	385	86	18·2 or 1 in 5·4

TABLE VI.—*Amputations. For 12 years (1875—1886), over 40 years of age.*

	Primary.			Secondary.			Pathological.			Expediency.			Total.		
	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.
Hip . . .	...	...	...	...	...	...	1	...	..	...	1	100 or 1 in 1	1	1	50 or 1 in 2
Thigh . . .	10	7	41·4 or 1 in 2·4	4	5	55·5 or 1 in 1·8	21	16	43·2 or 1 in 2·3	4	...	...	39	28	41·7 or 1 in 2·3
Leg . . .	14	14	50 or 1 in 2	11	11	50 or 1 in 2	15	9	37·5 or 1 in 2·6	6	1	14·2 or 1 in 7	46	35	43·2 or 1 in 2·3
Foot . . .	3	...	...	8	1	11·1 or 1 in 9	16	5	23·8 or 1 in 4·2	1	1	50 or 1 in 2	28	7	20 or 1 in 5
Shoulder . . .	2	1	33·3 or 1 in 3	...	2	100 or 1 in 1	1	...	...	...	...	...	3	3	50 or 1 in 2
Arm . . .	6	6	50 or 1 in 2	4	4	50 or 1 in 2	3	3	50 or 1 in 2	4	1	20 or 1 in 5	17	14	45·1 or 1 in 2·2
Forearm . . .	3	...	...	1	...	...	15	...	...	...	...	...	19	...	...
Total . . .	38	28	42·4 or 1 in 2·3	28	23	45·09 or 1 in 2·2	72	33	31·4 or 1 in 3·1	15	4	21·05 or 1 in 4·7	153	88	36·5 or 1 in 2·7

TABLE VII.—Amputations. For 12 years (1875—1886), 21—40 years of age inclusive.

	Primary.			Secondary.			Pathological.			Expediency.			Total.		
	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.
Hip . . .	...	...	...	...	...	...	2	4	66·6 or 1 in 1·5	1	3	75 or 1 in 1·3	3	7	70 or 1 in 1·4
Thigh . . .	9	2	18·1 or 1 in 5·5	6	4	40 or 1 in 2·5	35	13	27·08 or 1 in 3·6	5	...	...	55	19	25·6 or 1 in 3·8
Leg . . .	18	4	18·1 or 1 in 5·5	5	3	37·5 or 1 in 2·6	11	2	15·3 or 1 in 6·5	7	...	...	41	9	18 or 1 in 5·5
Foot . . .	5	...	...	2	...	...	28	...	...	5	...	...	40	...	...
Shoulder . . .	...	2	100 or 1 in 1	...	...	...	...	...	...	1	...	...	1	2	66·6 or 1 in 1·5
Arm . . .	9	3	25 or 1 in 4	2	2	50 or 1 in 2	9	1	10 or 1 in 10	1	...	...	21	6	22·2 or 1 in 4·5
Forearm . . .	11	...	...	2	1	33·3 or 1 in 3	4	...	...	2	...	...	19	1	5 or 1 in 20
Total . . .	52	11	17·4 or 1 in 5·7	17	10	37·03 or 1 in 2·7	89	20	18·3 or 1 in 5·4	22	3	12 or 1 in 8·3	180	44	19·6 or 1 in 5·09

TABLE VIII.—*Amputations. For 12 years (1875—1886), to 20 years of age inclusive.*

	Primary.			Secondary.			Pathological.			Expediency.			Total.		
	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.
Hip . . .	...	...	...	...	...	...	9	10	52·6 or 1 in 1·9	2	...	...	11	10	47·6 or 1 in 2·1
Thigh . .	14	8	36·3 or 1 in 2·7	1	3	75 or 1 in 1·3	69	17	19·7 or 1 in 5·05	9	2	18·1 or 1 in 5·5	93	30	24·3 or 1 in 4·1
Leg . . .	18	5	21·7 or 1 in 4·6	5	...	...	34	2	5·5 or 1 in 18	6	...	...	63	7	10 or 1 in 10
Foot . . .	3	...	...	...	...	...	37	1	2·6 or 1 in 38	5	...	...	45	1	2·17 or 1 in 46
Shoulder .	4	1	20 or 1 in 5	...	1	100 or 1 in 1	...	1	100 or 1 in 1	...	...	...	4	3	42·8 or 1 in 2·3
Arm . . .	17	1	5·5 or 1 in 18	3	1	25 or 1 in 4	7	...	...	2	...	...	29	2	6·4 or 1 in 15·5
Forearm .	12	...	...	2	...	...	5	...	...	...	...	...	19	...	...
Total . .	68	15	17·1 or 1 in 5·5	11	5	31·2 or 1 in 3·2	161	31	16·1 or 1 in 6·1	24	2	7·6 or 1 in 13	264	53	16·7 or 1 in 5·9

TABLE IX.—Amputations. For 12 years (1875—1886), for all ages.

	Primary.			Secondary.			Pathological.			Expediency.			Total.		
	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.	Re- covered.	Died.	Per cent.
Hip . . .	...	...	...	...	...	...	12	14	53·8 or 1 in 1·8	3	4	57·1 or 1 in 1·7	15	18	54·5 or 1 in 1·8
Thigh . . .	33	17	34 or 1 in 2·9	11	12	52·1 or 1 in 1·9	125	46	26·9 or 1 in 3·7	18	2	10 or 1 in 10	187	77	29·1 or 1 in 3·4
Leg . . .	50	23	31·5 or 1 in 3·1	21	14	40 or 1 in 2·5	60	13	17·8 or 1 in 5·6	19	1	5 or 1 in 20	150	51	25·3 or 1 in 3·9
Foot . . .	11	...	...	10	1	9·09 or 1 in 11	81	6	6·8 or 1 in 14·5	11	1	8·3 or 1 in 12	113	8	6·6 or 1 in 15·1
Shoulder . . .	6	4	40 or 1 in 2·5	...	3	100 or 1 in 1	1	1	50 or 1 in 2	1	...	...	8	8	50 or 1 in 2
Arm . . .	32	10	23·8 or 1 in 4·2	9	7	43·7 or 1 in 2·2	19	4	17·3 or 1 in 5·7	7	1	12·5 or 1 in 8	67	22	24·7 or 1 in 4·04
Forearm . . .	26	...	...	5	1	16·6 or 1 in 6	24	...	...	2	...	...	57	1	1·7 or 1 in 58
Total . . .	158	54	25·4 or 1 in 3·9	56	38	40·4 or 1 in 2·4	322	84	20·6 or 1 in 4·8	61	9	12·8 or 1 in 7·7	597	185	23·6 or 1 in 4·2

TABLE XI.—Principal Amputations performed during the years 1875—1880.

	1875.		1876.		1877.		1878.		1879.		1880.		Total.	
	Re-covered.	Died.	Re-covered.	Died.	Re-covered.	Died.	Re-covered.	Died.	Re-covered.	Died.	Re-covered.	Died.	Re-covered.	Died.
Primary	Thigh .	9	2	3	4	1	4	2	3	1	3	...	23	9
	Leg .	2	2	2	5	2	6	3	7	2	7	4	26	15
	Foot .	1	...	3	...	...	1	...	...	...	...	...	7	...
	Shoulder .	1	...	...	...	...	2	...	...	...	...	...	3	1
	Arm .	7	1	1	1	...	3	2	...	...	5	1	20	5
Secondary	Forearm .	1	...	5	2	...	2	...	2	...	1	...	13	...
	Thigh .	...	3	2	...	3	1	1	...	1	3	...	4	10
	Leg .	1	2	...	2	2	4	1	...	1	1	5	13	12
	Foot .	...	...	...	...	1	...	...	2	...	2	...	4	1
	Shoulder .	...	...	...	...	...	...	...	...	...	...	...	...	1
Pathological	Arm .	...	...	...	...	...	...	...	1	...	1	2	...	1
	Forearm .	1	...	2	1	...	1	...	...	...	...	...	6	4
	Hip .	4	...	4	...	...	2	...	...	...	1	1	4	1
	Thigh .	6	5	6	8	6	15	4	...	1	1	...	6	6
	Leg .	4	1	1	7	1	7	3	18	3	14	4	70	28
Expediency	Foot .	4	1	1	5	1	10	2	9	...	10	2	47	8
	Arm .	1	...	4	1	3	10	2	12	...	7	1	42	5
	Forearm .	2	...	5	...	...	...	...	2	...	...	1	8	4
	Hip .	...	1	...	1	...	...	1	2	...	1	...	10	...
	Thigh .	...	1	...	2	1	...	1	...	...	1	...	2	3
Total .	Leg .	...	...	...	...	...	...	...	...	...	...	...	7	2
	Foot .	...	...	...	...	...	1	...	3	...	1	...	5	...
	Arm .	2	...	...	...	1	2	...	4	...	1	...	7	1
	Forearm .	...	...	...	...	...	...	...	...	...	...	...	2	...
	...	...	...	...	...	...	...	...	...	...	...	...	1	...
Total .	47	18	52	24	39	23	61	20	72	10	59	22	330	117

TABLE XIII.—Sixteen Cases of Secondary Hæmorrhage.

Amputations.	No.	Age of patient.	Occlusion of vessels.	Day of occurrence.	Death.	Recovery.	Disease.
Primary	Thigh . . . 1	34	Torsion	13th, 14th, 15th, 18th, and 26th 2 months	...	Recovered	Compound fracture of tibia and fibula.
	Knee . . . 2	46	"		...	"	Compound fracture at site of syphilitic necrosis of tibia.
	Forearm . . 3	15	Catgut ligature and torsion	9th and 10th	...	"	Crushed hand.
Secondary	Knee . . . 4	30	Torsion	33rd	Same day	...	Tetanus (19th day) after compound fracture of tibia and fibula.
	Foot . . . 5	61	Catgut ligature	15th and 22nd	...	"	Secondary hæmorrhage (49th day) from posterior tibial artery (14 days) after compound fracture of os calcis.
	Hip . . . 6	44	"	26th (slight)	...	"	Old excision of hip.
Pathological	Thigh . . . 7	16	Torsion	15th and 21st 9th	21st day	...	Osteo-myelitis of femur with abscess of thigh.
	Thigh . . . 8	20	"	14th	10th day	...	Necrosis of femur and suppurating knee-joint.
	Thigh . . . 9	24	Catgut ligature	5th (slight)	...	"	Chronic ulcer of leg.
	Thigh . . . 10	26	"	11th (slight)	...	"	After excision for pulpy disease of knee, with necrosis.
	Thigh . . . 11	25	Silk ligature	34th and 37th	...	"	Destruction of knee-joint with chronic abscess.
	Thigh . . . 12	20	"	7th (slight)	4 months	...	Extensive suppurating of thigh after osteotomy for ankylosed hip.
	Thigh . . . 13	53	Torsion	9th (slight)	Same day	...	Destructive inflammation of knee-joint.
Expediency	Thigh . . . 14	36	Chronic catgut ligature	8th (slight)	...	"	Suppuration of thigh following excision for pulpy knee.
	Knee . . . 15	36	Catgut ligature	16th and 18th	...	"	Ununited fracture in infantile paralysis.
	Hip . . . 16	21	Torsion	18th day	18th day	...	Sarcoma of femur.

DESCRIPTION OF PLATE

Illustrating Mr. John Poland's Case of Secondary Hæmorrhage.

The illustration shows the posterior aspect of the popliteal artery and vein ending below, at the upper end of a small sloughy abscess-cavity, from which suppuration had extended upwards between the coats of the artery. The artery is laid open for an inch and a quarter above the separated coats, and a rod is passed down the lumen of the vessel within the separated internal coat and into the abscess-cavity below.

- A. Small sloughing abscess-cavity.
- B. Outer coats of artery thickened and imperceptibly blended below with the walls of the abscess-cavity.
- C. Upper limit of suppuration between the ^{tunica} ~~tissues~~ of the vessel.
- D. Inner coat lying loose like a tube or cast within the outer coats of the artery.
- E. Popliteal vein filled with clot,

C
B

A



F
C
B
D

